Check List the journal of biodiversity data

NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 19 (5): 703–708
https://doi.org/10.15560/19.5.703

PENSOFT

First record of *Centropomus undecimalis* (Bloch, 1792) (Perciformes, Centropomidae), Common Snook, in the Patos Lagoon estuary, in southern Brazil

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Abstract. We report the first record of *Centropomus undecimalis* (Bloch, 1792), Common Snook, in the Patos Lagoon estuary (32°S), Brazil. Two specimens were caught in April and May 2021 as bycatch in the fyke nets fishery for shrimp. *Centropomus undecimalis* was previously known to occur south to 29° S. We hypothesize that the intensification of the warm Brazilian Current has being promoted an expansion southward of this fish species along the Brazilian coast.

Keywords. Juvenile snooks, occurrence, poleward expansion, Western Atlantic

Academic editor: Hudson Tercio Pinheiro
Received 3 May 2023, accepted 25 September 2023, published 6 October 2023

Silveira S, Dumont LFC, Garcia AM, Lemos VM (2023) First record of *Centropomus undecimalis* (Bloch, 1792) (Perciformes, Centropomidae), Common Snook, in the Patos Lagoon estuary, in southern Brazil. Check List 19 (5): 703–708. https://doi.org/10.15560/19.5.703

Introduction

The family Centropomidae, represented by fish popularly known as snooks, contains 13 species of the genus *Centropomus* Lacépède, 1802 distributed along both Atlantic and Pacific coasts of America (Nelson et al. 2016; Carvalho-Filho et al. 2019; Figueiredo-Filho et al. 2021). Five of them are found in the Western Atlantic along the Brazilian coast: *Centropomus inrae* Carvalho-Filho, Oliveira, Soares & Araripe, 2019 (Oiapoque estuary to Pará, northern of Brazil), *C. ensiferus* Poey, 1860 and *C. pectinatus* Poey, 1860 (southeastern Florida to Rio de Janeiro, Brazil), *C. parallelus* Poey, 1860 (southeastern Gulf of Mexico to Rio Grande do Sul, Brazil) and *C. undecimalis* (Bloch, 1792), North Carolina to Santa Catarina, Brazil (Carvalho-Filho et al. 2019; Froese and Pauly 2022).

Centropomus species are euryhaline and semicatadromous, and they occur in coastal oceanic waters in diverse habitats, such as beaches, coral reefs, rocks, salt lakes, rivers, and estuaries in tropical and subtropical areas of the Americas (Gilmore et al. 1983; Rivas 1986; Carpenter 2002; Oliveira et al. 2014). Adults are generally found in rivers but move into estuarine systems to spawn (Gilmore et al. 1983). Spawning occurs at the mouths of inlets and along beaches, and rising tides facilitate the movement of eggs toward freshwater environments, the juveniles inhabit both fresh- and brackish-water areas (Peters et al. 1998). Estuaries are the primary nursery habitats, providing calm waters, protected shorelines, mud and sand substrata, and cover or overhanging shoreline vegetation (Gilmore et al. 1983). Subadults occur predominantly in higher salinity waters (Stevens et al. 2007).

Snooks are an important fishing resource on the western coast of the Atlantic Ocean (Taylor et al. 2000; Lowerre-Barbieri et al. 2003; FAO 2005; Alvarez-Lajonchère and Tsuzuki 2008; Ley and Allen 2013; Motta et al. 2016), for Central and South American countries (Lemos et al. 1978) and recreationally important sport

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Figure 1. Individuals of *Centropomus undecimalis*. **A.** Specimen 1 (68 mm total length). **B.** Specimen 2 (135 mm total length). Scale bars: 10 mm.

fish found from southern Brazil to south Florida (Purtlebaugh et al. 2020). In Brazil, *C. undecimalis* is considered a "noble fish" of high commercial value. Owing to its versatility in tolerating varied salinity conditions, it can be armed in fresh- and brackish-waters ponds on land (Liebl et al. 2016; Souza and Souza 2019; Nascimento et al. 2021). Centropomids have been cultured for over 300 years in extensive fish cultivation systems in the northeastern of Brazil. *Centropomus undecimalis* is a good candidate for aquaculture due to its favorable zootechnical characteristics, such as fast growth, a highly economic rate of feed conversion, and the potential to gain high biomass in aquaculture (Alvarez-Lajonchère and Tsuzuki 2008).

The Patos Lagoon estuary has been constantly studied for academic purposes and has a well-established and consolidated monitoring research program, the Brazilian Long-Term Ecological Research. The purpose of this program has been to investigate the environmental conditions and the biota in the estuary and adjacent marine regions since 1993 (Lemos et al. 2022). However, despite this ongoing research, no prior record of *C. undecimalis* has been found, until now. Here, we present the first record of *C. undecimalis* (Fig. 1) from the Patos lagoon estuary (32°S), which represents an extension south of its previously known geographic distribution by about 3 degrees latitude.

Methods

The catch occurred during fishing carried out for scientific research purposes and was made by passive nets of a local fisher. Passive net fishing gear uses light to attract primarily pink shrimp (MMA/SEAP 2004) but these nets also capture fish. The fishing activity was authorized by the relevant authorities (SISBIO no. 73514-1 and CEUA no. P009/2020). The specimens were identified following Figueiredo-Filho et al. (2021). The protocol of Bello et al. (2014) was followed to consolidate and validate the record.

Results

***Centropomus undecimalis* Bloch, 1792**

Figure 1

New record (Fig. 2). BRAZIL – **Rio Grande do Sul** • Patos Lagoon estuary; 32°01′S, 052°13′W; 1.5 m depth; 13.IV–14.V.2021; S. Silveira leg.; fished using passive nets; 2 ♂, ichthyology collection FURG-2943/2021 & 2944/2021.

The mean salinity and temperature were 16 ppm and 20 °C on 13.IV.2021, and 29 ppm and 14 °C on 14.V.2021.

Identification. The specimens were juvenile individuals, weighing 2.16 g, specimen 1 (specimen 1; Fig. 1A), and 21.9 g, specimen 2 (specimen 2; Fig. 1B). They had elongated body and head moderately compressed. Their head height was 18.5% of the standard length (SL) for specimen1 and 20.1% of SL for specimen 2; the body was relatively low, with a body depth of 24% of the SL for specimen1 and 27.6% of the SL for specimen 2. They lower jaw was protractile, longer than the upper jaw, and extending beyond tip of snout. The snout was narrow and long, comprising 9.3% of the SL for specimen 1 and 10.4% of the SL for specimen 2. The preoperculum margins were heavily serrated. The meristic and morphometric traits of these specimens are presented in Table 1.

Discussion

Centropomus undecimalis are protandrous hermaphrodites (Muller and Taylor 2000; Taylor et al. 2000) and generalist opportunistic predators (Souza et al. 2021) with euryhaline and diadromous habits (Taylor et al. 2000; Tavares and Luque 2003; Munyandorero et al. 2020). A close relationship with rivers and coastal lagoons has been observed for the *C. undecimalis* throughout its geographic range (Peters et al. 1998; Aliaume et al. 2005). This species occurs from North Carolina (USA), to Santa Catarina (Brazil) and can occasionally be found in northern Rio Grande do Sul (Figueiredo-Filho et al. 2021).

Centropomus undecimalis is known to be cold sensitive (Marshall 1958). It is stenothermic and thermophilic, and Shafland and Foote (1983) and Howells et al. (1990) considered a limiting factor for this species' occurrence cool water. The species is usually not found in water below 15 °C (Rivas 1986; Dantas and Barletta 2016). However, poleward expansion of *C. undecimalis* has been documented in Florida, USA by Purtlebaugh et al. (2020), who called attention to how the geographic range of this species expands with changing temperatures and that such expansions affect its ecology and interactions in estuarine habitats.

Here, we present the first record of *C. undecimalis* in the Patos Lagoon estuary, about three degrees of latitude south of its previous reported southern limit. Estuaries present ideal conditions for the growth of juveniles of *Centropomus* species (Rivas 1986; Dantas and Barletta 2016). We identified both captured specimens as *C. undecimalis* (instead of *C. paralellus*) on the basis of the longest anal-fin spine not reaching the caudal-fin origin when adpressed. *Centropomus undecimalis* differs from

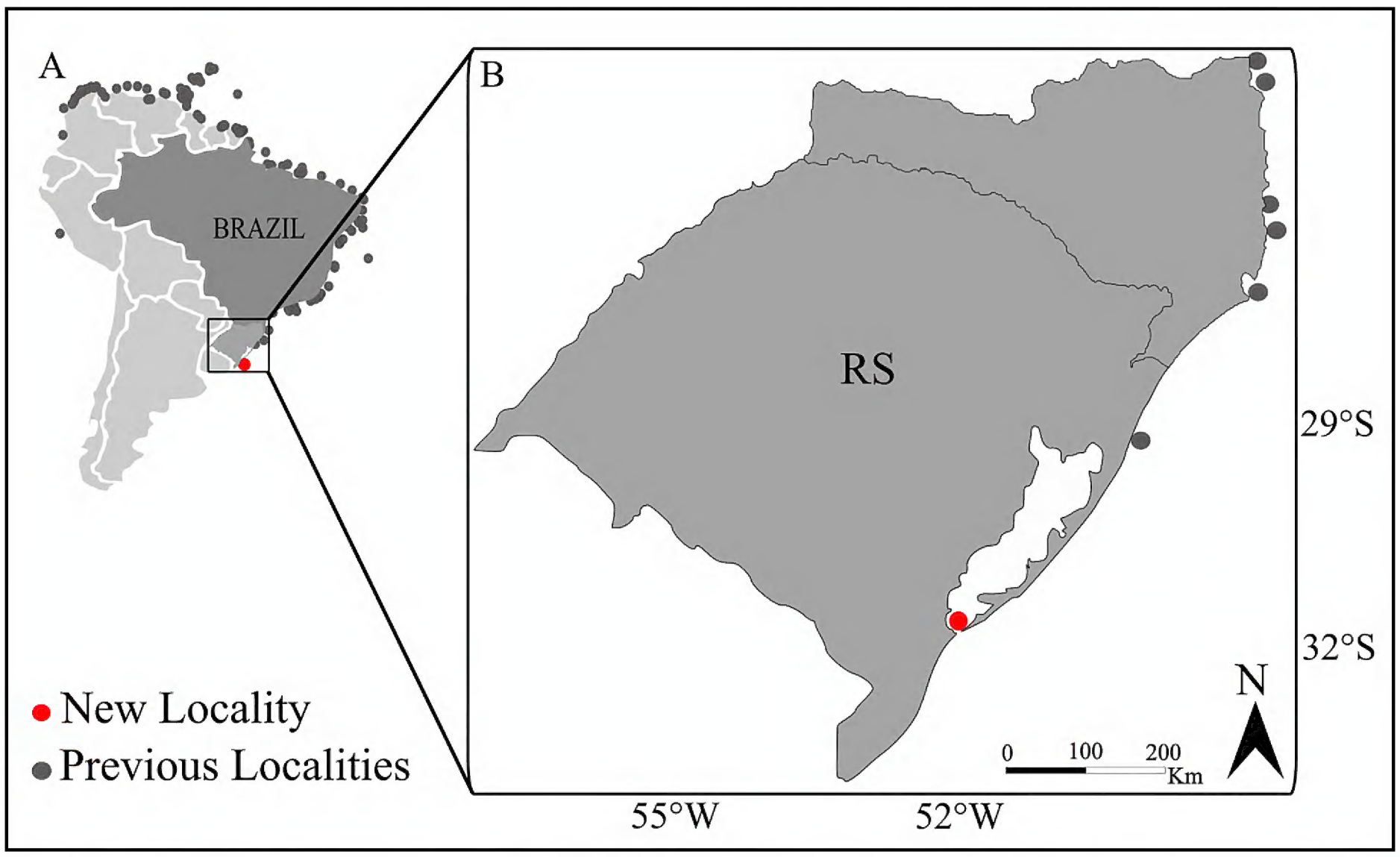

Figure 2. Distribution of *Centropomus undecimalis*. **A.** Distribution in the South America. **B.** Previous records (grey dots), and our new record (red dot) from Rio Grande do Sul (RS), Patos Lagoon estuary. Data from previous records obtained from https://mapper.obis.org/?taxonid=280068# and, Figueiredo et al. (2021).

Table 1. External measurements and meristic data of *Centropomus undecimalis* specimens caught in the Patos Lagoon estuary.

Measurements (in mm)	**Specimen 1**	**Specimen 2**
Total length	68	135
Standard length	54	105
Body height	13	29
Head height	10	21
Orbital diameter	6	8
Orbital height	5	7
Interorbital distance	4	6
Distance from orbit to gill membrane	9	15
Lower jaw length	11	14
Distance from snout to pectoral fin	17	36
Distance from snout to pelvic fin	21	41
Distance from snout to dorsal fin	21	42
Distance from snout to anal fin	36	74
Distance from snout to anterior orbit	5	11
First dorsal-fin base length	10	22
Second dorsal-fin base length	9	18
Total dorsal-fin base length	20	40
Longest spine of first dorsal fin length	4	7
Pelvic fin length	10	21
Longest spine of pelvic fin length	6	14
Anal-fin base length	7	13
Longest spine of anal fin length	14	28
Pectoral fin length	13	20
Caudal peduncle height	7	14
Caudal peduncle length	9	19
Meristic Characters	**Specimen 1**	**Specimen 2**
First dorsal fin (spines)	VIII	VIII
Second dorsal fin	I, 10	I, 10
Anal fin	III, 6	III, 7
Pectoral fin	14	14
Pelvic fin	I, 5	I, 5
Scales lateral line (to caudal base fin)	65	66
Scales lateral line (extending caudal base fin)	70	70
Scales above lateral line	10	9
Scales below lateral line	13	12
Lower limb gill rakers first arc	11	11
Gill rakers first arc	13	14
Gill rakers second arc	17	18

C. paralellus in which the longest anal-fin spine usually reaches the caudal-fin origin when adpressed (Figueiredo et al. 2021). Furthermore, *C. undecimalis* has a more elongated slenderer body compared to *C. paralellus* (Figueiredo et al. 2021). Identifying and reporting the occurrence of *C. undecimalis* in such an important nursery ground for several commercial species (Vieira and Castello 1996), is an important first step towards future research to predict potential environmental effects caused by its presence.

Centropomus undecimalis was collected in the Patos Lagoon estuary in the summer when temperatures are higher and more favourable for this species. Moreover, 2021, was an atypical, La Niña year (Li et al. 2022), during which rainfall was less than usual and the region was in drought (Grimm et al. 2000).

We hypothesize that the occurrence of these specimens south of the known geographic range of *C. undecimalis* may be associated with an intensification of the warm Brazilian Current. This current may promote the expansion southward along the Brazilian coast of *C. undecimalis*. In the summer of 2021, the average temperature of nearshore waters of Rio Grande do Sul state were ~20 °C (data obtained from buoy SimCosta RS-5). This warm-water period may have allowed *C. undecimalis* to reach Patos Lagoon. On entering the estuary, our specimens probably found favourable conditions until being captured.

Another occurrence of *C. undecimalis* was reported by Scenna et al. (2006) from the coast of Argentina, where they speculated that this species was transported by sea currents in the summer. More recently, Purtlebaugh et al. (2020) pointed out the shift poleward (northward) of this species due to ocean warming in the

Gulf of Mexico.

Although the Patos Lagoon estuary has been under ongoing study (Lemos et al. 2022), no prior record of *C. undecimalis* has been made until now. Currently, there is no evidence to unequivocally explain the occurrence of these specimens there, but our new data on *C. undecimalis* are important in the continued monitoring this subtropical estuary, which may be an important nursery ground for non-native fish.

Acknowledgements

We thank all personnel involved in our study and the undergraduate students for their assistance with laboratory work. We thank Ana Cecilia Giacometti Mai for her contribution with the identification and other suggestions; the Laboratório de Crustáceos Decápodes (FURG) for providing laboratory materials and equipment; the Coordination for the Improvement of Higher Education Personnel (CAPES), Brazil for the grant to SS; Fundação de Amparo à Pesquisa do Rio Grande do Sul, which provided research grant to VML; and the Brazilian Long-Term Ecological Research program in the Patos Lagoon estuary and adjacent marine coast; AMG thanks the CNPq for research fellowships (process no. 313008/2021-3)

Authors Contributions

Conceptualization: SS, LFCD, AMG, VML. Data curation: SS, VML. Funding acquisition: SS, LFCD, AMG, VML. Investigation: SS. Methodology: SS, VML. Visualization: SS, VML. Validation: SS, LFCD, AMG, VML. Writing – original draft: SS. Writing – review and editing: SS, LFCD, AMG, VML.

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